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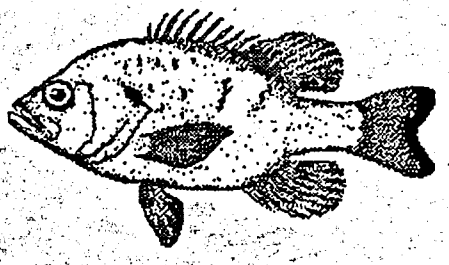
## Center for Aquatic Ecology

David C. Dowling, R. Weldon Larimore, and Peter B. Bayley

January 1990



Aquatic Ecology Technical Report 90/2

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# ASSEMBLING AN ELECTRIC SEINE: A TECHNICAL REFERENCE

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# ASSEMBLING AN ELECTRIC SEINE: A TECHNICAL REFERENCE

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## INTRODUCTION

This document includes a list of materials and assembly instructions for constructing a 30-ft (9.14-m) electric seine as described in SI units in Bayley, Larimore, and Dowling (1989). This design was tested in the early 1950's and has been used successfully since then in a variety of wadeable warmwater streams. A large data base of efficiency calibrations for this gear (and for a 50-ft version) in a variety of habitats is currently being analyzed to expand on earlier work of Larimore (1961). If you plan to use this gear quantitatively under similar conditions, we warn you that deviations from the design, materials, or method of operation will alter the efficiencies that we have estimated.

The 30-ft electric seine (Fig. 1) consists of a floating drop-electrode array plugged into hand-held electrodes at each end. It is powered by a portable, 120-V, AC generator with a voltage regulator rated for 1,800 W at 15 A maximum and 1,500 W at 12.5 A continuous output. Extending across the flow, this device is moved up and down a stream to collect fish.

Materials to construct an electric seine cost less than $200 (US) and can be assembled with ease. Appendix 1 provides a parts list for a 30-ft electric seine. We use English measurements because of the sizing of US parts. We apologize to those in countries that use the metric system and hope that they can determine equivalents from the English measurements.

## CONSTRUCTION

We recommend that these directions be read thoroughly. The following tools are recommended for seine assembly:

—wire cutters
—wire strippers
—pipe wrench
—crescent wrench (adjustable wrench)
—hacksaw
—soldering iron
—propane torch
—screwdrivers
—drill with 1/2-in. and 1/4-in. bits
—linesman pliers
—ruler
—permanent marker (*e.g.*, sharpie)
—pipe bender

### Drop-Electrode Array

Construction of the drop-electrode array begins by attaching one male twist-lock cord cap to the proximal end of a 328 1/2-in. segment of 14-gauge, 3-conductor cable and one female twist-lock cord cap to the distal end (Fig. 1). With a permanent marker, clearly write on the cord cap the color of the wire attached to each plug prong to ensure that the correct wiring sequence on the plug mates is followed.

Starting 15 in. from one end, carefully cut and remove the black cable insulation and the insulation of the white wire to expose a 3/4-in. section of one conductor. Progress along the

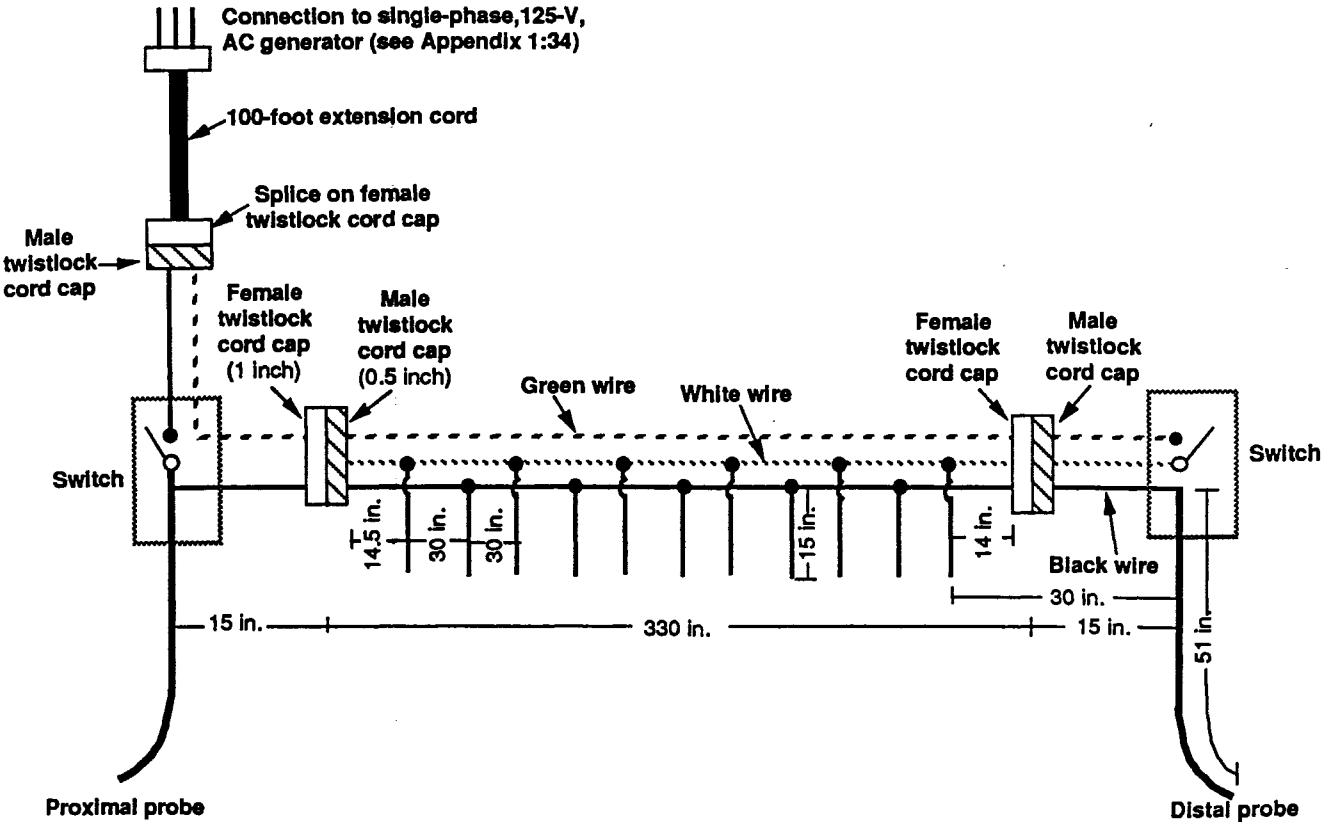


Fig. 1. Wiring diagram for a 30-ft electric seine (not to scale: reduced horizontally).

cable, cutting away insulation from alternating white and black conductor lines at 30-in. intervals (Fig. 2).

Cut brass strips into 3-in. segments. At each exposed point, wrap a 3-in. strip of 3/4-in. wide brass around the cable and solder the exposed wire to the inside middle portion of the brass strip (Fig. 2). Be careful not to melt the insulation on the other two conductors. Bring the brass strip ends tightly together, clamp with vise grips, and solder the three exposed edges. Drill a 1/4-in. hole whose center is 1/2-in. from the ends of the strip. The drop electrode will be bolted to the seine through these holes.

## Drop Electrodes

To manufacture the drop electrodes, cut 1/16-in. galvanized aircraft cable into 5-in. segments and the brass welding rods into 12-in. sections. Crimp a No. 8 ring solderless terminal on one end of each 5-in. segment of cable. Overlap 2 in. of the opposite end of the cable with the brass welding rod section and tightly wrap this area with a 5-in. piece of 24-gauge soft copper wire. Apply a thin layer of flux to this area and solder. To facilitate this task, use a propane torch rather than a soldering gun. The choice of aircraft cable is critical; it is a trade-off between flexibility (so that the electrodes hang vertically) and strength.

The resulting 15-in. electrode can then be bolted to an electric seine with a 8/32-in. x 1/2-in. brass machine screw and two 8/32-in. hex nuts. We strongly recommend that this connection be kept tight and clean. At regular intervals, all exposed copper and brass components should be sanded and damaged electrodes replaced to maintain the seine's efficiency.

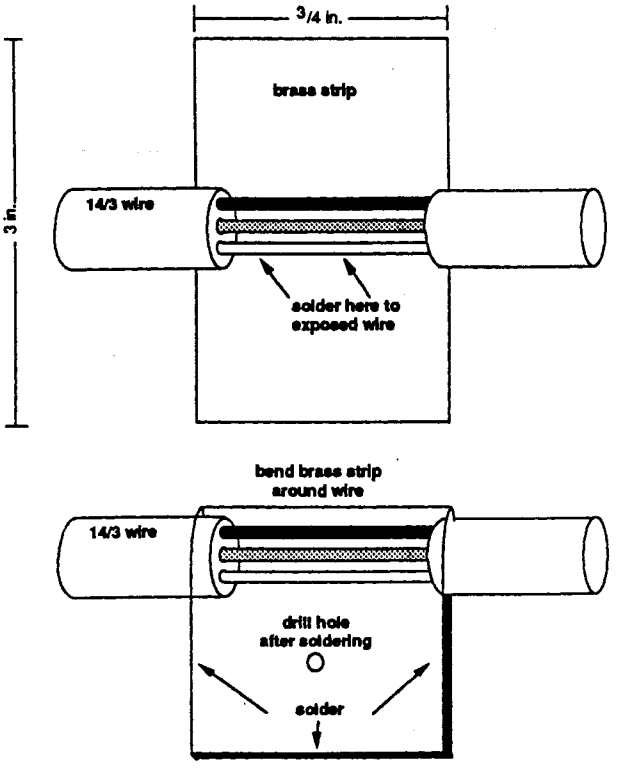


Fig. 2. Brass strip attachment to electric seine power line.

Only 11 electrodes are necessary for the seine to function, but a supply of spare electrodes is recommended to replace those damaged or lost with extended use. We suggest making up batches of 50-100 electrodes at a time and keeping replacements with you in the field.

## Proximal Probe Construction

For proximal probe construction, cut two 2-ft pieces (#2 and #3 in Fig. 3) and one 18 3/4-in. piece (#1 in Fig. 3) of hard copper conduit. Soft copper tubing breaks too easily and should not be used.

Sweat solder a 1/2-in. NPT x 5/8-in. I.D. hard copper fitting (piece B in Fig. 3) to one end of pieces #1 and #3 and to both ends of piece #2. To the latter piece, wrap both fittings with teflon tape, screw a condulet-T (piece C in Fig. 3) to one end and attach a 1/2-in. threaded PVC coupler (piece F) to the opposite end. This piece is important because it serves as an insulator between the probe handle and its lower conducting portion. Be careful when tightening the condulet-T since aluminum will fracture if overstressed.

Join to the threaded PVC coupler another piece of copper tubing (#3) that has been gradually bent midway to a 130° angle. This pipe is best bent with a pipe bender, thus eliminating crimps that will weaken the probe. We suggest keeping a replacement probe tip (#3) with you in the field. Remember to wrap the pipe fitting with teflon tape to reduce water leakage.

Cut a thin 5/8-in. long slot with a hacksaw at the bottom end of this piping (#3) on the top side; this slot will be used for wire attachment later. When tightening down the joints with a pipe wrench and a crescent wrench, make sure that the tip of the probe and the condulet-T are pointing in opposite directions (Fig. 3).

Drill a 1/2-in. hole in one condulet-T cover centered 1 1/2 in. from the top of the plate. This hole will be used to mount a safety toggle switch. Attach a second condulet-T to the top of the first so that both of the condulet faces and arms are oriented in the same direction. It may require several attempts to properly align the condulets. Connection is made by inserting a 1/2-in. steel close nipple, wrapped in pipe tape, between the two condulets.

To the top condulet-T, attach copper conduit piece #1, after wrapping the fitting with pipe tape. To the top of piece #1, sweat solder a 1/2-in. copper pipe cap (piece A). As a safety precaution, paint all portions of the probe assembly, excluding piece #3 (Fig. 3), with red

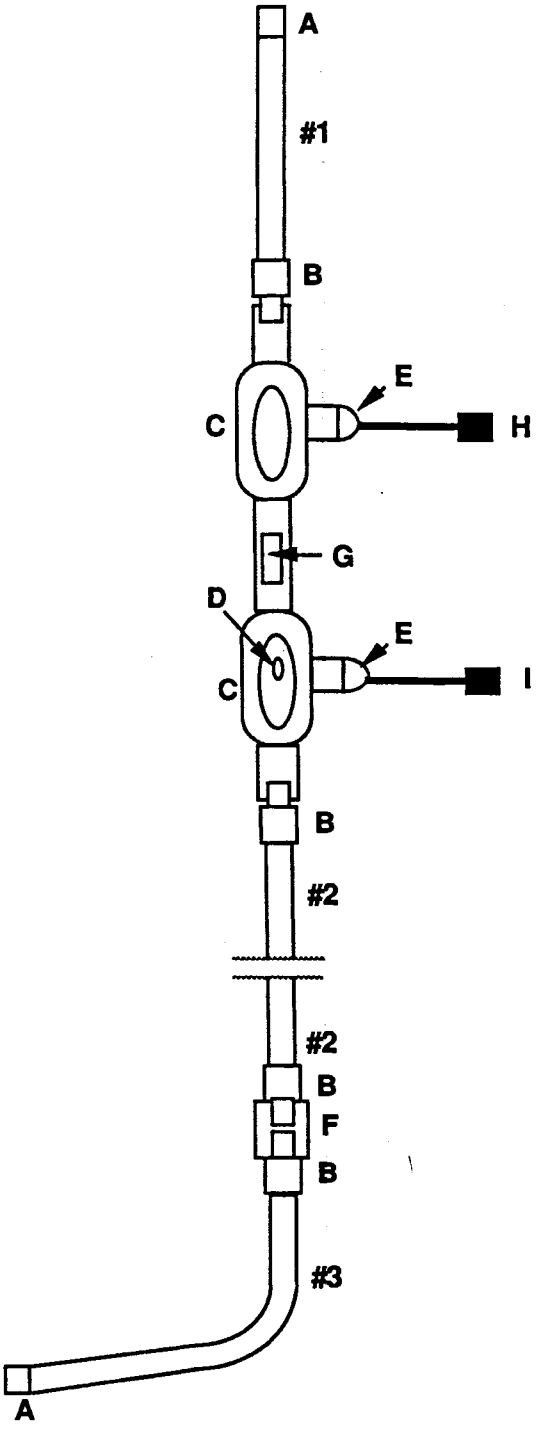


Fig. 3. Proximal probe assembly (not to scale). A = 1/2-in. copper pipe caps; B = 1/2-in. NPT x 5/8-in. I.D. tube fitting; C = 1/2-in. aluminum condulet-T; D = 1/2-in. hole in condulet-T cover; E = UF connector; F = 1/2-in. threaded PVC coupler; G = 1/2-in. close nipple (steel); H = male cord cap; I = female cord cap; #1 = 18 3/4-in. piece of copper tubing; #2 = 24-in. piece of copper tubing; #3 = 24-in. piece of copper tubing (see Appendix 1).

insulating varnish spray; this includes the covers and interior chambers of the condulet-Ts.

## Wiring the Proximal Probe

To wire the proximal probe, cut a 20-in. segment and a 16-in. segment of 14-gauge, 2-conductor cable. Using soapy water, slide a molded strain reliever onto each cord (Fig. 4). Place the narrow end of the reliever 9 1/2 in. from one end of each wire.

Over the tapered end of the strain reliever, place a 7/8-in. x 1/2-in. washer. From the other end of each wire, place a 7/8-in. x 3/8-in. washer and slide it up to the base of the strain reliever. Remove and discard the rubber gasket of the UF connector and slide the UF connector cap over the tapered end of each strain reliever. Slide the base of the UF connector up from the other end of the wire. Wrap pipe tape on the threads of these fittings and snuggly screw on each UF connector cap.

Strip 3/4 in. of insulation off both ends of each segment of wire. Attach a male twist-lock cord cap to the strain reliever end of the 20-in. wire segment and a female twist-lock cord cap to the 16-in. segment. The Illinois Department of Conservation uses cord caps with all plastic parts and the Illinois Environmental Protection Agency uses waterproof cord caps only. Although these are more expensive than generic plugs, they are a good investment.

When attaching the female cord cap, pay close attention to the proper wiring sequence (Fig. 1). Make sure the white wire corresponds with the green wire of the electric seine's male cord cap and the black wire with the black wire. Wrap pipe tape on the exposed threads of each UF connector. Insert the exposed end of the 20-in. wire segment into the upper condulet-T arm and the 16-in. segment into the lower condulet-T arm. Tighten down the fittings. The ends of

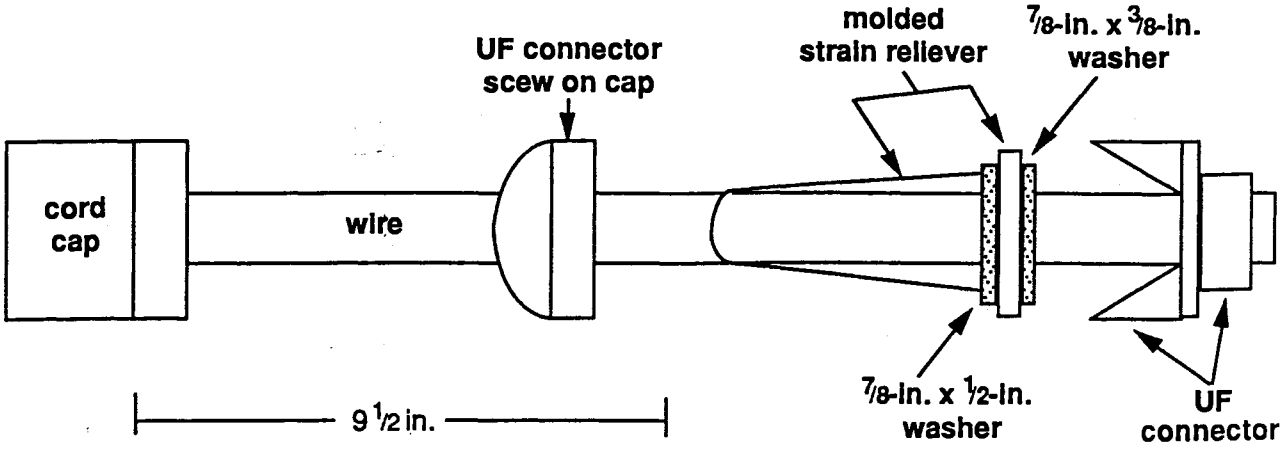


Fig. 4. UF connector hardware and wiring assembly.

both wires can now be connected to the safety switch in the lower condulet-T. Orient the switch with on up and off down. Connect the two exposed white wires with an orange wire connector (Fig. 5). Connect the upper black wire to the switch.

Cut a 54-in. segment and a 3-in. segment of black strand wire and strip 3/4 in. of insulation off each end. Attach the short piece of wire to the switch and feed the long wire from the probe tip to the switch box through the pipe.

In the switch box, connect the three exposed black wires with a yellow wire connector. At the probe tip, slip the wire into the precut slot, solder it to the outside of the pipe, and sweat on a pipe cap. Attach condulet-T gaskets and covers, secure the switch in the predrilled hole, and screw on the rubber switch boot.

Cut 25-in. and 19 1/2-in. segments of flexible rubber tubing. Split the hose down the center, position it on the probe over sections #1 and #2 (Fig. 3), and tape tightly with electrical tape.

## Distal Probe Construction

Distal probe construction is similar to proximal probe construction, differing primarily in wiring and slightly in design. Design changes include the use of only one condulet-T and three 2-ft pieces of hard copper conduit. The third 2-ft piece replaces the 18 3/4-in. piece of conduit and one condulet-T. Wiring requires a 16-in. segment of 14-gauge, 3-conductor cable and a 54-in. piece of black strand wire.

In the switch box, connect exposed black wires with an orange wire connector. Connect the green wire to the top of the toggle switch and the white wire to the remaining pole. When attaching the male twist-lock cord cap make sure that each wire lines up with the same colored wire in the electric seines female cord cap (Fig. 1). Two 25-in. segments of flexible rubber tubing will be needed to cover this probe.

## Final Preparation

For final preparation, center and liberally tape a 27-ft, rubber stoppered, air-filled float tube to the cable of drop electrodes. Plug the

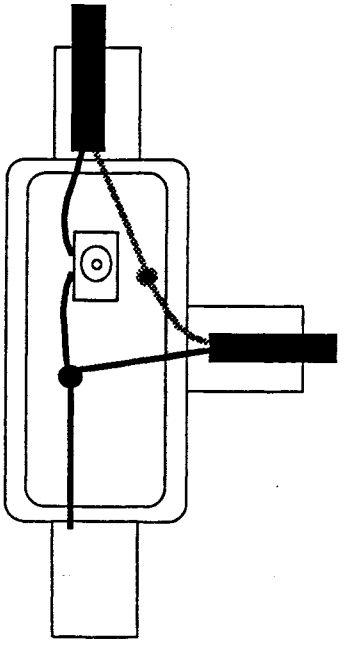

Fig. 5. Wiring of switch box on proximal probe.

seine into the hand-held electrodes and check all connections for electrical continuity. All switch boxes and UF connectors should now be heavily taped for further insulation. Splice the remaining female twistlock cap onto the 100-ft extension cord.

## ADDITIONAL COMMENTS

These instructions describe a design that was the culmination of building techniques and materials which were tested over several field seasons for ease of building, repair, durability, and low cost. If one is inclined to make any alterations to the seine's design, make sure that they will not alter the seine's efficiency, safety, or ease of operation.

We also caution against the use of any generator more powerful than those listed in Appendix 1. The electric seine has been designed and calibrated under specific electrical parameters. Generators of a greater wattage may cause damage to the seine and potential harm to the user.

The 50-ft electric seine, which has been calibrated for use on larger wadeable streams, is constructed in a similar manner to the 30-ft seine. The only difference is a drop-electrode array with 19 rather than 11 electrodes. This necessitates a 568½-in. piece of 14-gauge, 3-conductor cable, a 47-ft float tube, and 2 brass strips, 3 brass welding rods, 40 in. of aircraft cable, 8 machine screws, and 16 hex nuts in addition to parts required for the 30-ft seine.

A small gauge link chain attached between each probe and its adjacent float tube end should be used on the 50-ft electric seine and with the 30-ft electric seine in fast water to relieve the stress on the wires between these two points. The chain can be attached to the float tube ends with hose clamps and then readily tied or clipped to each probe when in use, keeping the chain slightly more taut than the wiring.

## REFERENCES

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Larimore, R.W. 1961. Fish population and electrofishing success in a warmwater stream. Journal of Wildlife Management 25:1-12.

## ACKNOWLEDGMENTS

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Appendix 1. Parts list for construction of one 30-ft electric seine.

| | Quantity | Product and Size |
|---|---|---|
| 1. | one (1) | 35-ft x 5/8-in. I.D. (15/16-in. O.D.) section of flexible rubber tubing |
| 2. | one (1) | 78 3/4-in. x 1/2-in. I.D. (5/8-in. O.D.) section of hard copper tubing |
| 3. | three (3) | aluminum 1/2-in. condulet T |
| 4. | three (3) | 1/2-in. condulet T covers |
| 5. | three (3) | rubber gaskets for condulet T |
| 6. | one (1) | 1/2-in. close nipple, steel |
| 7. | four (4) | 1/2-in. copper pipe caps |
| 8. | eight (8) | 1/2-in. NPT x 5/8-in. hard copper tube fitting |
| 9. | three (3) | water-tight service entrance cable connectors (1/2-in. UF connectors) |
| 10. | two (2) | 1/2-in. coupler, threaded PVC, schedule 80 |
| 11. | three (3) | molded strain relievers, 3-in. long x 5/16-in. I.D. (7/16-in. O.D.at top, 11/16-in. maximum O.D. at base plate) |
| 12. | two (2) | 15-A/125-V AC—10-A/250-V AC single pole, single throw toggle switches with rubber boots |
| 13. | three (3) | male twist-lock cord caps, 15-A/125-V |
| 14. | three (3) | female twist-lock cord caps, 15-A/125-V |
| 15. | one (1) | 36-in. section of 14/2 (14 gauge 2 conductor), 300-V, Type SJO wire |
| 16. | one (1) | 345-in. section of 14/3 14 gauge, 3 conductor), 300-V, Type SJO wire |
| 17. | one (1) | 111-in. section of wire strand, black thwn #14, copper, 600-V |
| 18. | one (1) | can of red insulating varnish spray |
| 19. | one(1) | roll of teflon thread seal, 1/2 in. x 100 in. |
| 20. | six (6) | 3/4-in. x 60-ft rolls of vinyl-plastic electrical tape |
| 21. | one (1) | roll 40/60 resin core solder, 1 lb |
| 22. | one (1) | can of flux-solder paste |
| 23. | three (3) | brass strips, 3/4 in. x 12 in. x 1/100-in. |
| 24. | four (4) | 3-ft x 1/8-in. uncoated brass welding rods |
| 25. | one (1) | roll of 25-gauge soft copper wire, 50 ft |
| 26. | eleven (11) | 5-in. sections of 1/16-in. galvanized aircraft cable |
| 27. | eleven (11) | brass round-head machine screws, 6/32 in. x 1/2 in. |
| 28. | twenty-two (22) | brass 6/32-in. hex nuts |
| 29. | one (1) | package of non-insulated, solderless terminals, ring no. 8, stud 16-14 |
| 30. | two (2) | #4 regular solid rubber stoppers |
| 31. | two (2) | orange wire connector (small) |
| 32. | one (1) | yellow wire connector (larger) |
| 33. | one (1) | 100-ft extension cord, 16 gauge |
| 34. | one (1) | Honda EM 1800X, 120-V, 1800-W, single-phase, 15-A maximum; 1500-W, 12.5-A continuous (this generator is no longer manufactured) |
| | | or |
| | one (1) | John Deere 1800, 120-V, 1800-W, single-phase, 15-A maximum; 1600-W, 13.3-A continuous |